

Safety Alert

Avoiding Glovebox Exposure Incidents

Gloveboxes must be designed and used properly to protect workers from hazardous materials and to safeguard sensitive materials from damage. These materials include radioactive materials, carcinogens, and materials that can react violently with air or water.

Inadequate oversight of a glovebox design from outside of LLNL as well as operating practices by non-Laboratory workers contributed to radioactive material uptakes to four glovebox workers at LLNL in August 2004. The resulting Price-Anderson fines (waived) were \$137,500. Details of the incident can be found in Lessons Learned LL-2005-LLNL-01, "Inadequate Review of Vendor Procedures Leads to Release of Radioactive Contamination," http://www-r.llnl.gov/es_and_h/lessons/05_01_inade_rvu.html

This Lessons Learned provides additional guidance for avoiding glovebox exposures.



Glovebox Worker

Concerns

- Contributing factors to the plutonium exposure event included:
 - The "soft" seals that connected drum containers or fixtures to the glovebox did not prevent leaks.
 - "Pumping" effects from several operators simultaneously entering gloveports caused transient overpressure conditions where glovebox pressure was greater than room pressure.
 - Workers did not respond to frequent glovebox low-vacuum alarms caused by operator induced pressure transients; they accepted the alarms as "normal operating conditions."
- Design characteristics of gloveboxes inherently limit operating practices. These limitations must be identified in the glovebox operating procedures with appropriate cautions, operational limits, and compensatory actions. However, compensatory procedural actions cannot replace adequate design criteria.

Recommended Actions for LLNL Employees

Users and Work Supervisors:

1. Inspect gloveboxes daily or prior to use:
 - Condition of gloves and glove seals
 - Proper pressure differential
 - Condition of the box and fittings
 - Condition and configuration of other systems installed on the box (e.g., valves and readings on pressure and flow gauges fall within acceptable ranges).
2. Be sure “soft” connections for articles attached to the box (e.g., drums, gloves, HEPA filters), are *completely* sealed. Even small leaks allow contaminants to escape and cause exposures.
3. Avoid abruptly extending gloves into the glovebox. This “pumping” can cause a pressure pulse that will result in airborne contamination. Multiple users need to coordinate their movement to prevent their actions from having a compounding affect.
4. Respond to off-normal indications or alarms in accordance with established procedures. Promptly convey problems and abnormal conditions to your work supervisor. Stop work until:
 - The cause and consequences of an alarm have been identified, and safe working conditions have been restored, and
 - The Responsible Individual has been notified of the alarm, workplace conditions, and corrective actions.
5. Understand the design features and limitations of a glovebox before using it, including:
 - Physical limitations of components, gloves, and support systems (e.g., barriers that maintain contamination control),
 - Ventilation/vacuum controls that maintain a pressure differential between the glovebox and the outside,
 - Atmospheric controls (e.g., controlling oxygen concentrations), and
 - Features that prevent over-pressurization, flooding, and fire.

Responsible Individuals:

1. Periodically assess gloveboxes to determine if ventilation design and monitoring requirements are adequate for authorized operations. Record the results of these assessments using a logbook (or other durable, easily retrievable record) for each glovebox. The record should to include:
 - A characterization of the type and intended use of the glovebox,
 - Ventilation monitoring and design information,
 - Glovebox use history, and
 - Applicable operating procedures, alarm response procedures, and safety plans.
2. Conspicuously label gloveboxes with the following:
 - The identifying information about the glovebox and authorized types of work activities,
 - Appropriate hazard warning labels, and
 - The names and phone numbers of the RI and other knowledgeable persons to contact about the glovebox.
3. Provide pressure relief systems designed and installed in accordance with Document 18.1, “Pressure,” in the *ES&H Manual*. Institute administrative controls for any glovebox attached to a pressurized gas or liquid system. Over-pressurization can cause a breach in the glovebox, endangering the user, damaging other equipment, spreading hazardous contaminants, and letting air with oxygen and moisture into the box. This design criterion especially applies to existing systems when they are being connected to a pressurized support system for the first time. Pressure relief systems should be retrofitted into existing systems that do not have adequate pressure relief.
4. Very early in the conceptual stage, contact your ES&H Team in order to identify subject matter experts (SMEs) for your specific type of glovebox application. Integrate the SMEs into the design process. This will prevent committing to inadequate designs that are hard to use or fail to meet LLNL requirements. Proper involvement of SMEs early in the design process should significantly streamline the formal design review process.

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